

Relatório da correção da prática IV

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Motivo do erro:

O código criou n threads (n = número de processadores do computador) para cada requisição. Portanto, ao realizar 4096 requisições em um computador com 32 threads, 131.072 threads são utilizadas. Como o computador e a lógica do código não suportam essa quantidade de threads, ocorreu o erro ao realizar as 4096 requisições.

Solução do erro:

Criei uma thread para cada requisição:

```
@Service
public class Thread {

    public Future<?> create(Path p) {
        ExecutorService es = Executors.newSingleThreadExecutor();
        return es.submit(new DownloadFile(p));
    }
}
```

ExecutorService:

“An Executor that provides methods to manage termination and methods that can produce a Future for tracking progress of one or more asynchronous tasks.”

submit(): “Method submit extends base method Executor.execute(java.lang.Runnable) by creating and returning a Future that can be used to cancel execution and/or wait for completion. .”

Fonte: <https://docs.oracle.com/javase/7/docs/api/java/util/concurrent/ExecutorService.html>

Executors.newSingleThreadExecutor():

“Creates an Executor that uses a single worker thread operating off an unbounded queue, and uses the provided ThreadFactory to create a new thread when needed. ”

Fonte: <https://docs.oracle.com/javase/7/docs/api/java/util/concurrent/Executors.html>

Future:

“A Future represents the result of an asynchronous computation. Methods are provided to check if the computation is complete, to wait for its completion, and to retrieve the result of the computation. The result can only be retrieved using method get when the computation has completed, blocking if necessary until it is ready. Cancellation is performed by the cancel method. Additional methods are provided to determine if the task completed normally or was cancelled. Once a computation has completed, the computation cannot be cancelled. If you would like to use a Future for the sake of cancellability but not provide a usable result, you can declare types of the form Future<?> and return null as a result of the underlying task.”

Fonte: <https://docs.oracle.com/javase/7/docs/api/java/util/concurrent/Future.html>

```

public class DownloadFile implements Callable {

    private final Path p;

    public DownloadFile(Path p) { this.p = p; }

    public ByteArrayResource download() throws IOException{
        return new ByteArrayResource(Files.readAllBytes(this.p));
    }

    @Override
    public ByteArrayResource call() {
        try{
            return this.download();
        }
        catch(IOException e){
            e.printStackTrace();
        }
        return null;
    }
}

```

Callable: “A task that returns a result and may throw an exception. Implementors define a single method with no arguments called call.

The Callable interface is similar to Runnable, in that both are designed for classes whose instances are potentially executed by another thread. A Runnable, however, does not return a result and cannot throw a checked exception.”

Call: “Computes a result, or throws an exception if unable to do so.”

Fonte: <https://docs.oracle.com/javase/7/docs/api/java/util/concurrent/Callable.html>

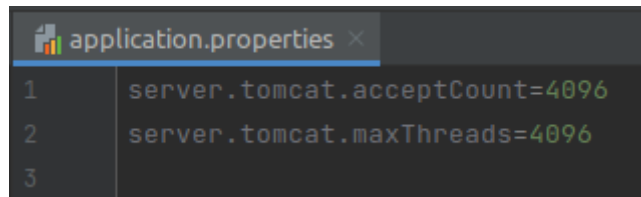
ByteArrayResource: “Creates a ByteArrayInputStream for the given byte array. Useful for loading content from any given byte array, without having to resort to a single-use InputStreamResource”

Fonte: <https://docs.spring.io/spring-framework/docs/current/javadoc-api/org/springframework/core/io/ByteArrayResource.html>

Files.readAllBytes(): “Reads all the bytes from a file. The method ensures that the file is closed when all bytes have been read or an I/O error, or other runtime exception, is thrown. Note that this method is intended for simple cases where it is convenient to read all bytes into a byte array. It is not intended for reading in large files..”

Fonte: <https://docs.oracle.com/javase/7/docs/api/java/nio/file/Files.html>

Altere as configurações padrões do tomcat:

A screenshot of a code editor showing the 'application.properties' file. The file contains two lines of configuration: 'server.tomcat.acceptCount=4096' and 'server.tomcat.maxThreads=4096'. The line numbers 1, 2, and 3 are visible on the left side of the editor.

```
1 server.tomcat.acceptCount=4096
2 server.tomcat.maxThreads=4096
3
```

server.tomcat.acceptCount: “The maximum length of the operating system provided queue for incoming connection requests when maxConnections has been reached. The operating system may ignore this setting and use a different size for the queue. When this queue is full, the operating system may actively refuse additional connections or those connections may time out. The default value is 100.”

server.tomcat.max-threads: “The maximum number of request processing threads to be created by this Connector, which therefore determines the maximum number of simultaneous requests that can be handled. If not specified, this attribute is set to 200. If an executor is associated with this connector, this attribute is ignored as the connector will execute tasks using the executor rather than an internal thread pool. Note that if an executor is configured any value set for this attribute will be recorded correctly but it will be reported (e.g. via JMX) as -1 to make clear that it is not used.”

Fonte: <https://tomcat.apache.org/tomcat-9.0-doc/config/http.html>

Instruções:

1) Executar o .jar

- 1) Abra o terminal e navegue até Trabalho_01/target
- 2) Digite `java -jar Trabalho_01-0.0.1-SNAPSHOT.jar`
- 3) Abra o navegador no computador 1 e digite <http://localhost:8080/arq1.dat>
- 4) Abra o navegador no computador 1 e digite <http://localhost:8080/arq2.dat>
- 5) Abra o navegador no computador 2 e digite `http://<ip_do_computador_1>:8080/arq1.dat`
- 6) Abra o navegador no computador 2 e digite `http://<ip_do_computador_1>:8080/arq2.dat`

2) Executar na IDE

- 1) Baixe a IDE IntelliJ Community: <https://www.jetbrains.com/pt-br/idea/download/> ou utilize outra IDE (O passo a passo deve ser semelhante)
- 2) Descompacte o arquivo `idea-IC-213.6641.79.tar.gz`
- 3) Abra o terminal e navegue até `idea-IC-213.6641.79.tar/bin`
- 4) Digite `./idea.sh`
- 5) Aperte Open -> Trabalho 01 (Ao fazer isso, o maven será baixado e as bibliotecas externas serão baixadas por meio do maven)
- 6) Insira o arquivo que será baixado no seguinte caminho `Trabalho_01/src/resources/static` (Obs: `arq1.dat` e `arq2.dat` já estão presentes nesse caminho)
- 7) Vá até `Trabalho_01\src\main\java\com\work\one\Trabalho01Application.java`
- 8) Aperte em run `Trabalho01Application.java`
- 9) Abra o navegador no computador 1 e digite `http://localhost:8080/<nome_do_arquivo>.<extensão_do_arquivo>`
- 10) Abra o navegador no computador 2 e digite `http://<ip_do_computador_1>:8080/<nome_do_arquivo>.<extensão_do_arquivo>`

Ambiente de teste:

RAM: 20gb

HD: 500gb

PROCESSADOR: i7 - oitava geração (8 núcleos)

SISTEMA OPERACIONAL: Ubuntu 20.04

JAVA: Versão 17

Testes:

```
euller@euller-PC:~/Downloads$ ulimit -n 5000
```

```
GNU nano 4.8 test.sh
#!/bin/bash

read -p "Nome do aluno: " file
read -p "Porta: " porta

for j in {1..2}; do
  for i in {6..12}; do
    x=$((2**$i))
    ab -n $x -c $x http://localhost:$porta/arq$j.dat >> $file.txt
    printf "#####\t" >> $file.txt
    printf "n: %d, c: %d" $x $x >> $file.txt
    printf "\n\n" >> $file.txt
  done
done
```

[15 linhas lidas]

^G Obter Ajuda	^O Gravar	^W Onde está?	^K Recort txt	^J Justificar	^C Pos atual
^X Sair	^R Ler o arq	^_ Substituir	^U Colar txt	^T Verforçog	^_ Ir p/ linha

```
Finished 1024 requests
Completed 204 requests
Completed 408 requests
Completed 612 requests
Completed 816 requests
Completed 1020 requests
Completed 1224 requests
Completed 1428 requests
Completed 1632 requests
Completed 1836 requests
Completed 2040 requests
Finished 2048 requests
Completed 409 requests
Completed 818 requests
Completed 1227 requests
Completed 1636 requests
Completed 2045 requests
Completed 2454 requests
Completed 2863 requests
Completed 3272 requests
Completed 3681 requests
Completed 4090 requests
Finished 4096 requests
euller@euller-PC:~/Downloads
```

Benchmarking localhost (be patient).....done

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq1.dat
Document Length: 2097152 bytes

Concurrency Level: 64
Time taken for tests: 0.153 seconds
Complete requests: 64
Failed requests: 0
Total transferred: 134231296 bytes
HTML transferred: 134217728 bytes
Requests per second: 419.40 [#/sec] (mean)
Time per request: 152.600 [ms] (mean)
Time per request: 2.384 [ms] (mean, across all concurrent requests)
Transfer rate: 859012.12 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	2 0.8	2	3
Processing:	11	104 44.4	133	146
Waiting:	3	67 37.7	70	131
Total:	11	106 43.9	135	147

Percentage of the requests served within a certain time (ms)

50% 135
66% 143
75% 145
80% 146
90% 146
95% 147
98% 147
99% 147
100% 147 (longest request)

n: 64, c: 64

Benchmarking localhost (be patient).....done

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq1.dat
Document Length: 2097152 bytes

Concurrency Level: 128
Time taken for tests: 0.300 seconds
Complete requests: 128
Failed requests: 0
Total transferred: 268462592 bytes
HTML transferred: 268435456 bytes
Requests per second: 426.26 [#/sec] (mean)
Time per request: 300.284 [ms] (mean)
Time per request: 2.346 [ms] (mean, across all concurrent requests)
Transfer rate: 873075.16 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	3 0.5	3	4
Processing:	12	183 90.2	199	294
Waiting:	2	149 78.8	154	277
Total:	12	186 89.9	202	296

Percentage of the requests served within a certain time (ms)

50%	202
66%	240
75%	282
80%	288
90%	294
95%	295
98%	296
99%	296
100%	296 (longest request)

n: 128, c: 128

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq1.dat
Document Length: 2097152 bytes

Concurrency Level: 256
Time taken for tests: 0.596 seconds
Complete requests: 256
Failed requests: 0
Total transferred: 536925184 bytes
HTML transferred: 536870912 bytes
Requests per second: 429.38 [#/sec] (mean)
Time per request: 596.213 [ms] (mean)
Time per request: 2.329 [ms] (mean, across all concurrent requests)
Transfer rate: 879452.48 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	7 1.2	7	10
Processing:	23	400 204.2	528	585
Waiting:	3	255 146.9	260	510
Total:	29	407 204.3	535	592

Percentage of the requests served within a certain time (ms)

50% 535
66% 569
75% 580
80% 582
90% 587
95% 591
98% 592
99% 592
100% 592 (longest request)

n: 256, c: 256

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq1.dat
Document Length: 2097152 bytes

Concurrency Level: 512
Time taken for tests: 1.314 seconds
Complete requests: 512
Failed requests: 0
Total transferred: 1073850368 bytes
HTML transferred: 1073741824 bytes
Requests per second: 389.76 [#/sec] (mean)
Time per request: 1313.623 [ms] (mean)
Time per request: 2.566 [ms] (mean, across all concurrent requests)
Transfer rate: 798312.76 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	14 1.1	14	15
Processing:	28	735 469.2	720	1292
Waiting:	3	609 362.1	672	1180
Total:	43	749 469.1	734	1306

Percentage of the requests served within a certain time (ms)

50% 734
66% 1224
75% 1269
80% 1280
90% 1297
95% 1302
98% 1305
99% 1305
100% 1306 (longest request)

n: 512, c: 512

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq1.dat
Document Length: 2097152 bytes

Concurrency Level: 1024
Time taken for tests: 2.649 seconds
Complete requests: 1024
Failed requests: 0
Total transferred: 2147700736 bytes
HTML transferred: 2147483648 bytes
Requests per second: 386.51 [#/sec] (mean)
Time per request: 2649.321 [ms] (mean)
Time per request: 2.587 [ms] (mean, across all concurrent requests)
Transfer rate: 791660.96 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	31 1.6	31	33
Processing:	106	1690 851.4	2036	2595
Waiting:	4	1187 686.0	1258	2387
Total:	138	1721 850.5	2067	2627

Percentage of the requests served within a certain time (ms)

50% 2067
66% 2502
75% 2551
80% 2568
90% 2605
95% 2615
98% 2620
99% 2621
100% 2627 (longest request)

n: 1024, c: 1024

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq1.dat
Document Length: 2097152 bytes

Concurrency Level: 2048
Time taken for tests: 5.574 seconds
Complete requests: 2048
Failed requests: 0
Total transferred: 4295401472 bytes
HTML transferred: 4294967296 bytes
Requests per second: 367.42 [#/sec] (mean)
Time per request: 5573.952 [ms] (mean)
Time per request: 2.722 [ms] (mean, across all concurrent requests)
Transfer rate: 752559.05 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	63 2.7	64	66
Processing:	347	3711 1449.1	4083	5457
Waiting:	3	2431 1545.1	2283	5220
Total:	411	3774 1447.6	4148	5516

Percentage of the requests served within a certain time (ms)

50% 4148
66% 4802
75% 5098
80% 5255
90% 5479
95% 5499
98% 5510
99% 5512
100% 5516 (longest request)

n: 2048, c: 2048

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq1.dat
Document Length: 2097152 bytes

Concurrency Level: 4096
Time taken for tests: 11.280 seconds
Complete requests: 4096
Failed requests: 0
Total transferred: 8590802944 bytes
HTML transferred: 8589934592 bytes
Requests per second: 363.12 [#/sec] (mean)
Time per request: 11279.922 [ms] (mean)
Time per request: 2.754 [ms] (mean, across all concurrent requests)
Transfer rate: 743751.24 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	127 4.0	125	135
Processing:	840	6722 3097.4	7189	11026
Waiting:	3	5276 3178.2	5506	10753
Total:	973	6849 3094.4	7313	11150

Percentage of the requests served within a certain time (ms)

50% 7313
66% 8795
75% 9819
80% 10274
90% 10932
95% 11125
98% 11143
99% 11147
100% 11150 (longest request)

n: 4096, c: 4096

Benchmarking localhost (be patient).....done

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq2.dat
Document Length: 6291456 bytes

Concurrency Level: 64
Time taken for tests: 0.432 seconds
Complete requests: 64
Failed requests: 0
Total transferred: 402666752 bytes
HTML transferred: 402653184 bytes
Requests per second: 148.27 [#/sec] (mean)
Time per request: 431.650 [ms] (mean)
Time per request: 6.745 [ms] (mean, across all concurrent requests)
Transfer rate: 910990.96 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	2 0.4	2	3
Processing:	37	347 110.5	404	421
Waiting:	7	173 96.6	174	323
Total:	37	349 110.3	406	422

Percentage of the requests served within a certain time (ms)

50% 406
66% 416
75% 420
80% 421
90% 422
95% 422
98% 422
99% 422
100% 422 (longest request)

Benchmarking localhost (be patient).....done

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq2.dat
Document Length: 6291456 bytes

Concurrency Level: 128
Time taken for tests: 0.780 seconds
Complete requests: 128
Failed requests: 0
Total transferred: 805333504 bytes
HTML transferred: 805306368 bytes
Requests per second: 164.12 [#/sec] (mean)
Time per request: 779.925 [ms] (mean)
Time per request: 6.093 [ms] (mean, across all concurrent requests)
Transfer rate: 1008377.09 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	3 0.5	3	4
Processing:	34	407 214.9	382	769
Waiting:	6	375 226.0	369	760
Total:	35	410 214.7	385	773

Percentage of the requests served within a certain time (ms)

50% 385
66% 529
75% 607
80% 659
90% 722
95% 756
98% 772
99% 772
100% 773 (longest request)

n: 128, c: 128

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq2.dat
Document Length: 6291456 bytes

Concurrency Level: 256
Time taken for tests: 1.726 seconds
Complete requests: 256
Failed requests: 0
Total transferred: 1610667008 bytes
HTML transferred: 1610612736 bytes
Requests per second: 148.32 [#/sec] (mean)
Time per request: 1725.944 [ms] (mean)
Time per request: 6.742 [ms] (mean, across all concurrent requests)
Transfer rate: 911337.22 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	9 2.1	8	13
Processing:	35	1194 567.6	1521	1706
Waiting:	7	857 414.9	889	1441
Total:	35	1203 566.4	1529	1718

Percentage of the requests served within a certain time (ms)

50% 1529
66% 1574
75% 1693
80% 1698
90% 1706
95% 1710
98% 1715
99% 1717
100% 1718 (longest request)

n: 256, c: 256

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq2.dat
Document Length: 6291456 bytes

Concurrency Level: 512
Time taken for tests: 3.716 seconds
Complete requests: 512
Failed requests: 0
Total transferred: 3221334016 bytes
HTML transferred: 3221225472 bytes
Requests per second: 137.78 [#/sec] (mean)
Time per request: 3716.021 [ms] (mean)
Time per request: 7.258 [ms] (mean, across all concurrent requests)
Transfer rate: 846559.80 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	16 1.1	16	19
Processing:	59	2609 1177.5	3376	3675
Waiting:	8	1585 944.9	1723	3260
Total:	75	2626 1178.2	3392	3693

Percentage of the requests served within a certain time (ms)

50% 3392
66% 3540
75% 3585
80% 3592
90% 3671
95% 3692
98% 3693
99% 3693
100% 3693 (longest request)

n: 512, c: 512

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq2.dat
Document Length: 6291456 bytes

Concurrency Level: 1024
Time taken for tests: 7.455 seconds
Complete requests: 1024
Failed requests: 0
Total transferred: 6442668032 bytes
HTML transferred: 6442450944 bytes
Requests per second: 137.36 [#/sec] (mean)
Time per request: 7454.750 [ms] (mean)
Time per request: 7.280 [ms] (mean, across all concurrent requests)
Transfer rate: 843981.09 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	41 1.6	41	44
Processing:	146	4992 2050.4	5071	7363
Waiting:	8	3339 2019.1	3175	6982
Total:	190	5033 2049.8	5111	7403

Percentage of the requests served within a certain time (ms)

50% 5111
66% 6463
75% 7084
80% 7231
90% 7321
95% 7383
98% 7403
99% 7403
100% 7403 (longest request)

n: 1024, c: 1024

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq2.dat
Document Length: 6291456 bytes

Concurrency Level: 2048
Time taken for tests: 14.989 seconds
Complete requests: 2048
Failed requests: 0
Total transferred: 12885336064 bytes
HTML transferred: 12884901888 bytes
Requests per second: 136.63 [#/sec] (mean)
Time per request: 14989.178 [ms] (mean)
Time per request: 7.319 [ms] (mean, across all concurrent requests)
Transfer rate: 839494.73 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	71 3.3	71	77
Processing:	196	8897 4301.0	9074	14841
Waiting:	7	7138 4193.3	7130	14451
Total:	270	8968 4298.8	9143	14906

Percentage of the requests served within a certain time (ms)

50% 9143
66% 11471
75% 12790
80% 13733
90% 14728
95% 14851
98% 14900
99% 14904
100% 14906 (longest request)

n: 2048, c: 2048

Benchmarking localhost (be patient)

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /arq2.dat
Document Length: 6291456 bytes

Concurrency Level: 4096
Time taken for tests: 29.827 seconds
Complete requests: 4096
Failed requests: 0
Total transferred: 25770672128 bytes
HTML transferred: 25769803776 bytes
Requests per second: 137.32 [#/sec] (mean)
Time per request: 29827.121 [ms] (mean)
Time per request: 7.282 [ms] (mean, across all concurrent requests)
Transfer rate: 843751.30 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	149 5.1	150	157
Processing:	306	16365 8448.6	16206	29523
Waiting:	7	14380 8454.5	14281	29003
Total:	450	16514 8451.2	16360	29677

Percentage of the requests served within a certain time (ms)

50%	16360
66%	21358
75%	23622
80%	25058
90%	27938
95%	29368
98%	29662
99%	29671
100%	29677 (longest request)
##### n: 4096, c: 4096	

Tempo total arq1.dat: 0.153 + 0.300 + 0.596 + 1.314 + 2.649 + 5.574 + 11.280 = 21, 866 segundos
Tempo total arq2.dat: 0,432 + 0,780 + 1,726 + 3,716 + 7,455 + 14, 989 + 29, 827 = 58, 925 segundos